REMARKS

By the present amendment and response, independent claim 7 has been amended to overcome the Examiner's objections. Claims 7-11 and 21-47 are pending in the present application and claims 21-47 have been allowed. Reconsideration and allowance of outstanding claims 7-11 in view of the following remarks are requested.

The Examiner has rejected claims 7 and 10-11 under 35 USC §103(a) as being unpatentable over U.S. patent number 6,146,959 to DeBoer et al ("DeBoer") in view of U.S. patent number 6,488,823 B1 to Chiang et al. ("Chiang"). For the reasons discussed below, Applicant respectfully submits that the present invention, as defined by amended independent claim 7, is patentably distinguishable over DeBoer and Chiang, singly or in combination.

The present invention, as defined by amended independent claim 7, teaches, among other things, a capacitor comprising "a first and a second layer of metallic tantalum nitride, said first layer of metallic tantalum nitride being situated between said dielectric comprising ceramic tantalum nitride and said first capacitor electrode and said second layer of metallic tantalum nitride being situated between said dielectric comprising ceramic tantalum nitride and said second capacitor electrode." As disclosed in the present application, the present invention can achieve ceramic tantalum nitride by fabricating tantalum nitride with a nitrogen content of at least 30%. In the ceramic mode, tantalum nitride exhibits a high dielectric constant, which allows the present invention to

utilize ceramic tantalum nitride as a dielectric to advantageously achieve a capacitor having a relatively high capacitance density.

As further disclosed in the present application, the fabrication of ceramic tantalum nitride can be easily integrated in copper processes. For example, a layer of ceramic tantalum nitride could be fabricated as a dielectric above a copper interconnect segment without having to take the semiconductor wafer out of the vacuum chamber for a separate fabrication of the dielectric. Thus, by utilizing ceramic tantalum nitride as a dielectric in a capacitor having copper plates, the present invention advantageously achieves a capacitor having a relatively high capacitance density that can advantageously be built with higher throughput while advantageously reducing the risk of wafer contamination.

Furthermore, as disclosed in the present application, first and second metallic tantalum nitride layers are situated between respective first and second copper interconnect metal layer segments, i.e. respective first and second capacitor electrodes, to advantageously prevent copper diffusion. As disclosed in the present application, the first and second metallic tantalum nitride layers can be deposited by employing an ionized metal plasma ("IMP") tool utilizing a tantalum target and adjusting the percentage of nitrogen partial flow in the argon-nitrogen gas mixture sustaining the plasma to a level so as to result in a metallic tantalum nitride film with a nitrogen content of approximately 21%.

In contrast to the present invention as defined by amended independent claim 7, DeBoer does not teach, disclose, or suggest a capacitor comprising "a first and a second

layer of metallic tantalum nitride, said first layer of metallic tantalum nitride being situated between said dielectric comprising ceramic tantalum nitride and said first capacitor electrode and said second layer of metallic tantalum nitride being situated between said dielectric comprising ceramic tantalum nitride and said second capacitor electrode." DeBoer specifically discloses a capacitor including first capacitor plate 34, nitride layer 36 situated over first capacitor plate 34, Ta_2O_5, i.e. tantalum pentoxide, layer 38 situated over nitride layer 36, barrier layer 40 situated over Ta_2O_5 layer 38, metal nitride layer 42 situated over barrier layer 40, and second capacitor plate 44 situated over metal nitride layer 42. See, for example, column 3, lines 50-67, column 4, lines 62-67, column 5, lines 1-13, and Figure 4 of DeBoer. Thus, DeBoer discloses a tantalum pentoxide layer, i.e. Ta_2O_5 layer 38, which is different than ceramic tantalum nitride. Thus, DeBoer does not teach, disclose, or suggest forming ceramic tantalum nitride.

Furthermore, DeBoer is concerned with developing alternative methods of utilizing tantalum pentoxide in integrated circuit construction as a result of the high dielectric constant of tantalum pentoxide, i.e. approximately 25. See, for example, DeBoer, column 1, lines 16-17, and column 2, lines 47-48. In contrast, as disclosed in the present application, the dielectric constant of ceramic tantalum nitride is approximately 10. Thus, since tantalum pentoxide has a higher dielectric constant than ceramic tantalum nitride, DeBoer would not be motivated to replace a dielectric having a higher dielectric constant, i.e. tantalum pentoxide, with a dielectric having a lower dielectric constant, i.e. ceramic tantalum nitride.

Also, DeBoer fails to teach, disclose, or suggest a first and a second layer of metallic tantalum nitride, where the first layer of metallic tantalum nitride is situated between a dielectric comprising ceramic tantalum nitride and a first capacitor electrode and a second layer of metallic tantalum nitride is situated between the dielectric comprising ceramic tantalum nitride and a second capacitor electrode. Moreover, DeBoer fails to teach, disclose, or suggest fabricating a capacitor having copper plates. As discussed above, the present invention advantageously utilizes ceramic tantalum nitride as a dielectric in a capacitor having copper plates to achieve a capacitor with relatively high capacitance that can advantageously be built with higher throughput while advantageously reducing the risk of wafer contamination. However, DeBoer fails to teach, disclose, or even remotely suggest a similar motivation or other motivation for combining ceramic tantalum nitride and copper to fabricate a capacitor. Thus, DeBoer further fails to teach, disclose, or even remotely suggest a motivation for situating ceramic tantalum nitride between metallic tantalum nitride layers to prevent copper diffusion.

In contrast to the present invention as defined by independent claim 7, Chiang does not teach, disclose, or suggest a capacitor comprising "a first and a second layer of metallic tantalum nitride, said first layer of metallic tantalum nitride being situated between said dielectric comprising ceramic tantalum nitride and said first capacitor electrode and said second layer of metallic tantalum nitride being situated between said dielectric comprising ceramic tantalum nitride and said second capacitor electrode."

Chiang is directed to controlling residual stress in a tantalum or tantalum nitride film during deposition by adjusting process variables which have counteracting effects on the residual film stress. The Examiner has cited Chiang to disclose that when the atomic nitrogen content of a tantalum nitride film exceeds about 45% to about 50%, the resistivity of the tantalum nitride film increases drastically. See, for example, Chiang, column 9, lines 27-36. However, Chiang does not teach or disclose a dielectric comprising ceramic tantalum nitride having a nitrogen content of at least 30%. In fact, Chiang does not even mention ceramic tantalum nitride.

Also, Chiang fails to teach, disclose, or remotely suggest a first and a second layer of metallic tantalum nitride, where the first layer of metallic tantalum nitride is situated between a dielectric comprising ceramic tantalum nitride and a first capacitor electrode and a second layer of metallic tantalum nitride is situated between the dielectric comprising ceramic tantalum nitride and a second capacitor electrode. Thus, Chiang fails to cure the basic deficiencies of DeBoer discussed above.

For the foregoing reasons, Applicant respectfully submits that the present invention, as defined by amended independent claim 7, is not suggested, disclosed, or taught by DeBoer and Chiang. Thus, amended independent claim 7 is patentably distinguishable over DeBoer and Chiang and, as such, claims 10 and 11 depending from independent claim 7 are, *a fortiori*, also patentably distinguishable over DeBoer and Chiang for at least the reasons presented above and also for additional limitations contained in each dependent claim.

The Examiner has further rejected claims 8 and 9 under 35 USC §103(a) as being unpatentable over DeBoer in view of Chiang and further in view of U.S. patent number 5,170,318 to Catala et al ("Catala"). As discussed above, amended independent claim 7 is patentably distinguishable over DeBoer and Chiang and, as such, claims 8 and 9 depending from independent claim 7 are, *a fortiori*, also patentably distinguishable over DeBoer and Chiang for at least the reasons presented above and also for additional limitations contained in each dependent claim. Moreover, the features of amended independent claim 7, for example a dielectric comprising ceramic tantalum nitride situated between a first and a second layer of metallic tantalum nitride, are not suggested, disclosed, or taught anywhere in Catala. As such, amended independent claim 7 as well as claims 8 and 9 depending therefrom are also patentably distinguishable over DeBoer and Chiang in combination with Catala.

Based on the foregoing reasons, the present invention, as defined by amended independent claim 7, and claims depending therefrom, is patentably distinguishable over the art cited by the Examiner. Thus, claims 7-11 are patentably distinguishable over the art cited by the Examiner. For all the foregoing reasons, an early allowance of outstanding claims 7-11, and an early Notice of Allowance for all pending claims 7-11 and 21-47 is respectfully requested.

Attorney Docket No.: 99CON103P-DIV1

Respectfully Submitted,
FARJAMI & FARJAMI LLP

Date: 8/24/04

Michael Farjami, Esq.
Reg. No. 38, 135

Michael Farjami, Esq.
FARJAMI & FARJAMI LLP
26522 La Alameda Ave., Suite 360
Mission Viejo, California 92691
Telephone: (949) 282-1000
Facsimile: (949) 282-1002

CERTIFICATE OF FACSIMILE TRANSMISSION
I hereby certify that this correspondence is being filed by facsimile transmission to United States Patent and Trademark Office at facsimile number 703-872-9306 on the date stated below. The facsimile transmission report indicated that the facsimile transmission was successful.

Date of Facsimile: 8/24/2004

LESLEY L. LAM
Name of Person Performing Facsimile Transmission

Signature 8/24/04
Date

CERTIFICATE OF MAILING
I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed: Mail Stop RCE, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

Date of Deposit: _____

_____
Name of Person Mailing Paper and/or Fee

_____
Signature Date